What is claimed is:

1. A catalyst composition, comprising:

Co and Mo disposed on a support material wherein the majority of the Mo occurs as dispersed Mo oxide clusters and the majority of the Co occurs in a $CoMoO_4$-like phase with the Co therein primarily in an octahedral configuration, and wherein the $CoMoO_4$-like phase occurs substantially disposed upon the dispersed Mo oxide clusters.

2. The catalyst composition of claim 1 wherein the support material is silica.

3. The catalyst composition of claim 1 wherein the molar ratio of Co:Mo is less than 3:4.

4. The catalyst composition of claim 1 wherein the support material is not a carbon nanotube.

5. The catalyst composition of claim 1 wherein the Mo oxide clusters comprise Mo oxide clusters having a domain size between that of MoO_3 and heptamolybdate.

6. A method of preferentially forming single walled carbon nanotubes having a particular diameter, comprising:

providing a catalyst comprising:

Co and Mo disposed on a support material wherein the majority of the Mo occurs as dispersed Mo oxide clusters and the majority of the Co occurs in a $CoMoO_4$-like phase with the Co therein primarily in an octahedral configuration, and wherein the $CoMoO_4$-like phase occurs substantially disposed upon the dispersed Mo oxide clusters; and

exposing the catalyst in a reactor to a carbon-containing gas at a temperature between about 700°C and about 800°C and maintaining a CO_2 concentration in the reactor below a threshold CO_2 concentration above which the conversion of ionic Co to metallic Co is inhibited, wherein the majority of the single walled carbon nanotubes thus formed have a diameter between about .7 nm to about .9 nm.

7. The method of claim 6 wherein in the step of providing a catalyst, the support material is silica.

8. The method of claim 6 wherein in the step of exposing the catalyst to a carbon-containing gas, the reactor has a pressure therein between about 1 atm and 7 atm.

9. The method of claim 6 wherein in the step of exposing the catalyst to a carbon-containing gas, the threshold CO_2 concentration in the reactor is 1%.

10. The method of claim 6 wherein in the step of exposing the catalyst to a carbon-containing gas, the carbon-containing gas is CO.

11. The method of claim 6 comprising the additional step of reducing the catalyst by exposing the catalyst to a heated hydrogen gas.

12. The method of claim 6 wherein in the step of providing a catalyst, the support material of the catalyst is not a carbon nanotube.

13. The method of claim 6 wherein in the step of providing a catalyst, the Mo oxide clusters comprise Mo oxide clusters having a domain size between that of MoO_3 and heptamolybdate.

14. A method of preferentially forming single walled carbon nanotubes having a particular diameter, comprising:

providing a catalyst comprising:

Co and Mo disposed on a support material wherein the majority of the Mo occurs as dispersed Mo oxide clusters and the majority of the Co occurs in a $CoMoO_4$-like phase with the Co therein primarily in an octahedral configuration, and wherein the $CoMoO_4$-like phase occurs substantially disposed upon the dispersed Mo oxide clusters; and

exposing the catalyst in a reactor to a carbon-containing gas at a temperature between about 800°C and about 900°C and maintaining a CO_2 concentration in the reactor below a threshold CO_2 concentration above which the conversion of ionic Co to metallic Co is inhibited, wherein the majority of the single walled carbon nanotubes thus formed have a diameter between about .9 nm to about 1.2 nm.

15. The method of claim 14 wherein in the step of providing a catalyst, the support material is silica.

16. The method of claim 14 wherein in the step of exposing the catalyst to a carbon-containing gas, the reactor has a pressure therein between about 1 atm and 7 atm.

17. The method of claim 14 wherein in the step of exposing the catalyst to a carbon-containing gas, the threshold CO_2 concentration in the reactor is 1%.

18. The method of claim 14 wherein in the step of exposing the catalyst to a carbon-containing gas, the carbon containing gas is CO.

19. The method of claim 14 comprising the additional step of reducing the catalyst by exposing the catalyst to a heated hydrogen gas.

20. The method of claim 14 wherein in the step of providing a catalyst, the support material of the catalyst is not a carbon nanotube.

21. The method of claim 14 wherein in the step of providing a catalyst, the Mo oxide clusters comprise Mo oxide clusters having a domain size between that of MoO_3 and heptamolybdate.

22. A method of preferentially forming single walled carbon nanotubes having a particular diameter, comprising:

providing a catalyst comprising:

Co and Mo disposed on a support material wherein the majority of the Mo occurs as dispersed Mo oxide clusters and the majority of the Co occurs in a $CoMoO_4$-like phase with the Co therein primarily in an octahedral configuration, and wherein the $CoMoO_4$-like phase occurs substantially disposed upon the dispersed Mo oxide clusters; and

exposing the catalyst in a reactor to a carbon-containing gas at a temperature between about 900°C and about 1,000°C and maintaining a CO_2 concentration in the reactor below a threshold CO_2 concentration above which the conversion of ionic Co to metallic Co is inhibited, wherein the majority of the single walled carbon nanotubes thus formed have a diameter between about 1.3 nm to about 1.7 nm.

23. The method of claim 22 wherein in the step of providing a catalyst, the support material is silica.

24. The method of claim 22 wherein in the step of exposing the catalyst to a carbon-containing gas, the reactor has a pressure therein between about 1 atm and 7 atm.

25. The method of claim 22 wherein in the step of exposing the catalyst to a carbon-containing gas, the threshold CO_2 concentration in the reactor is 1%.

26. The method of claim 22 wherein in the step of exposing the catalyst to a carbon-containing gas, the carbon-containing gas is CO.

27. The method of claim 22 comprising the additional step of reducing the catalyst by exposing the catalyst to a heated hydrogen gas.

28. The method of claim 22 wherein in the step of providing a catalyst, the support material of the catalyst is not a carbon nanotube.

29. The method of claim 22 wherein in the step of providing a catalyst, the Mo oxide clusters comprise Mo oxide clusters having a domain size between that of MoO_3 and heptamolybdate.